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Building University Innovation Ecosystems: The Role of Work Integrated Learning as a Core Element in the University-Industry Nexus.

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Abstract

Universities can be seen as innovation ecosystems contributing towards national innovation capacity via the commercialization of university research. While existing research predominantly focuses on university staff activities related to industry, the critical role of the student in contributing towards innovation efforts have often been overlooked and should be leveraged further as it is an important impetus for broader innovation outcomes. Students can contribute to innovation outcomes through various work integrated learning activities such as industry placements and work based projects. Therefore, by focusing on the student, the objective of the research is to develop a model for building effective university innovation ecosystems through work integrated learning as a nexus between university and industry. It provides important implications for university innovation policies and management frameworks to build university innovation ecosystems.

Keywords: Innovation Policy; Innovation Ecosystems; University Industry Networks; Work Integrated Learning.

1. Introduction

The innovation capacity of a country is critical for its economic performance and competitiveness. This is a prominent issue in both developed countries such as Australia, the United States, the United Kingdom and Germany as well as developing countries such as China and India [1]. Increasingly, the role of universities in building the innovation capacity of countries is attracting increased attention [2, 3]. A university can be seen as an innovation ecosystem as it consists of a live set of actors that also engage with the broader regional and national innovation ecosystems through relationships with industry [4, 5]. Jackson [6] explains that an innovation ecosystem refers to complex relationships between actors and entities, with a goal of technology development and innovation. She argues that the ecosystem comprises actors such as students, faculties, researchers and entities including schools of engineering and business as well as industry-engagement units [6]. Universities can contribute towards innovation in several ways via consulting, new firm spinoffs, technology licensing, technology and service commercialization, and university technology transfer to either established or new companies [7, 8].

In particular, the area of Work Integrated Learning (WIL) through student internships or placements has received increasing attention in the innovation management literature. Otherwise termed cooperative education, work-based learning or experiential learning, WIL 'combines learning in the classroom and learning on the job. Students put their academic knowledge into action through relevant (and usually paid) work experiences with real-world employers, then bring their on-the-job challenges and insights back to class for further analysis and reflection' [9, p. 1]. WIL has been seen as beneficial for both employers and students. For employers, WIL is important in recruitment strategies for non-committal access to sourcing high-quality talent. For instance, 'Golman Sachs employed over 80 per cent of their new employees in 2008 and 2009 through their internship programs…and Hewlett Packard has a tradition of employing approximately 70 per cent of their new employees from their former

interns' [10, p. 93]. For students, WIL improves career opportunities, work readiness, organizational fit and job satisfaction [11-13].

Given the need for a focus on the student in the innovation system, this research specifically examines the research question of 'How can university innovation ecosystems be developed through work integrated learning as a core component in the nexus between university and industry'? Therefore, anticipated managerial implications will be highly relevant and significant in determining strategies for universities to best foster innovation through effective WIL initiatives with industry. Much rhetoric on the role of universities and its linkage with industry is prevalent by governments. However, few studies unpack how innovation can be achieved by universities in partnership with industry. Therefore, managerial implications from this study will be of significance in competitively positioning universities to harness its innovation capacity and contribute effectively to national innovation systems.

The study will be based on a case-study of a medium sized university in Australia. WIL has grown in prominence throughout the higher education sector in Australia featuring in over 60% of Australian university degree programs [14] and consequently it is a suitable context for investigation as it has enjoyed a high level of reflection, dialogue and critique about the opportunities as well as challenges involved in WIL [15]. The University under investigation is seen as appropriate as WIL is a core component of all undergraduate degrees and has been recognized for its leadership in WIL [16]. The study will first provide a review of the innovation literature and the factors influencing the effective management of WIL for achieving innovation outcomes. It is based on qualitative research capturing both student and industry perspectives on the role of WIL in innovation. Implications will be provided for building university ecosystems through WIL as a nexus between university and industry.

2. Theoretical Background

Innovation is increasingly being seen as the third mission of universities beyond education and research [17, 18]. Universities are developing their strategic orientations around competitively positioning themselves as innovative universities to build reputation among potential students and industry partners for their innovative programs and capabilities. Furthermore, governments are also demanding that universities contribute towards regional innovation and economic development in order to secure public funding for their initiatives [19, 20]. Consequently, there is a shift in universities towards being innovative through high-tech spinoffs, technology commercialization, stimulating economic development and entrenching innovative mindsets in students [21].

While much research has been conducted on staff commercialization activities, more research is needed on the critical role of the student [22]. In developing innovation capabilities in students, the classroom setting is seen as too safe . WIL is growing in prominence as it provides an opportunity to students for business networking, customer engagement, development of pertinent skills of persistence and resilience, enthusiasm, resourcefulness and entrepreneurial passion for a cause [23]. Increasingly, the role of WIL in developing innovation and creativity skills have been recognized [24]. Therefore, WIL is an important component in building university innovation ecosystems. In developing such ecosystems through WIL, the WIL literature introduces a number of WIL policy, management, and industry engagement issues to ensure that WIL initiatives are scalable and effective in achieving innovation outcomes.

2.1. University WIL Policy

WIL has grown in prominence from its 'cottage industry' roots to a 'new enterprise in higher education' that requires a holistic shift in the policies, systems and frameworks throughout the organization [16]. Orrell [25] calls for a focus in developing policies throughout the university to support WIL:

"University leadership and management have major responsibilities to ensure that university governance accounts for resources, policies and infrastructure to support students, staff, industry partners and diverse WIL contexts. [25, p. 15]"

Despite the need for appropriate policies and systems, audits of WIL programs have found a skew towards junior and female staff members in WIL coordination activities, leading to calls for increased recognition in university policies surrounding recruitment, promotion and performance management frameworks so that staff involved in WIL will not be disadvantaged but be recognized in promotion and performance evaluation activities [26-29]. Promotion and performance within traditional universities are generally measured by research output and therefore it is important for appropriate WIL policies to be developed.

2.2. WIL Management framework

In addition to developing WIL policies and integrating them within wider university systems, the management of WIL programs requires careful consideration to be cost effective and sustainable [30]. Many universities struggle with the resource intensity of WIL programs due to the high levels of engagement required to develop meaningful relationships with industry and to oversee the successful execution of student projects. Furthermore, academic life is facing increased pressures of research output and teaching larger cohorts of students. WIL adds a further layer of complexity. Several scholars examine the 'speeding up' [31] and the 'fast' pace of academia stemming from policies and practices of higher education [32]. Successful implementation of WIL programs require reflection,

participation and negotiation with academic, administrative, employer and student stakeholders to gauge the level of support and resources required given the unique characteristics of the university and its cohort [33].

The role of the Placement Coordinator is vital in the effective management of WIL programs. It is important in developing and maintaining strong links with industry, forging other forms of collaboration, matching students with employers and ensuring that WIL projects are executed to a high standard. Coll and Eames [34] examine various models of placement coordination including from purely administrative roles to joint positions as placement coordinators and teaching academics to purely academic positions. Depending on the size of the WIL program, these roles may be espoused within dedicated or combined administrative and academic personnel and include a range of administrative as well as academic activities. Bates [35] argues that WIL involves professional and academic duties which are beyond the scope of traditional duties used by universities in allocating workloads for academic and administrative staff. She outlines details of both academic duties (such as setting up of learning contracts of students, continuous contact with industry, building collaborative relationships and remaining aware of employment trends, professional training and workshops to prepare students for the workplace, monitoring student progress and appropriate interventions in difficult cases) and administrative duties (including database maintenance, continuous marketing, management of individual WIL placement agreements with industry, sourcing details of placement projects and making them available to students, and compliance with operational requirements). She calls for more research to examine students and employer perspectives reporting on the level of university support and supervision [35].

2.3. The use of ICT in WIL administration

To assist with WIL administrative duties, the use of information and communication technology (ICT) has been introduced. Taylor [30] investigates the extent to which the 15 'Technikons' or Polytechnics in South Africa use ICT and specifically the WIL cooperative education module of university-wide software systems (Integrated Tertiary Software (ITS)) to manage their WIL programs. These WIL modules assist in storing and querying WIL information, monitoring the progress of students and matching students to placements at host employers. Typical data stored in the system include student data linked to the broader university database, employer contact information, placement project details, company/student visit information and supervisor/mentor information. It was found that South African higher education institutions are not using ICT in managing WIL programs to the extent that they should. Streamlining the efficiency and effectiveness of such programs with the help of ICT is paramount as student numbers grow and given the heightened prevalence of WIL programs[30]. ICT is increasingly important in managing relationships involving a large number of organizations, such as WIL hosts [36, 37].

2.4. Industry Engagement and Scalability

With increases in student numbers, industry engagement through outreach efforts and building strong relationships with industry is important for ensuring that there are sufficient WIL opportunities for students. Therefore, it is critical to foster the scalability of WIL programs through deep, collaborative engagement with industry to meet increasing demand. To ensure engagement with industry and the scalability of WIL, strategies are important which focus on the outreach to alumni, targeting key nodes such as industry associations with access to a large number of industry member organizations and recognition of participating firms to ensure ongoing and increased participation in WIL programs.

Furthermore, as the higher education sector is becoming more globalized and as the competition increases for scarce public R&D funding, more innovative approaches are needed to attract industry engagement. Reinhard et al. [38] argue that scarce funding is generally channeled to a handful of elite universities and provide a case study in the German context whereby WIL is seen as an important mechanism to increase industry engagement through student-consultancy projects where students contribute towards solving specific business issues. In this way, WIL provides a timely and pragmatic approach to engagement between university and industry [38].

2.5. Innovation Outcomes

The innovation management literature has generally focused on commercialization outcomes such as patents. However, patents are limited in capturing broader forms of innovation that may not be patentable such as service innovation or may not be cost-effective to patent such as innovations stemming from small firms [39, 40]. Alternatively, the number of new products and services commercialized may be a more holistic measure of innovation outcomes compared to patents [8]. Furthermore, some authors use indicators such as regional innovation and economic development as measures of innovation outcomes [41]. Additionally, there are additional calls for research to examine outcomes from the perspective of firms in terms of how WIL can be used in the attraction and hiring of skilled students [10, 42, 43].

3. Method

The development of university innovation ecosystems is still in its embryonic stage and therefore the study employs a qualitative approach which is appropriate in exploring emerging multifaceted processes [44]. It was based on a case study of a WIL program involving science and engineering students in a mid-sized university in Australia, given the prominence of WIL nationally [15], featuring in over 60% of courses [14]. Case studies are suitable in capturing complex details of reality [45]. The design of the study incorporated in-depth interviews with placement students and industry supervisors, whereby participants were encouraged to discuss their experiences from the WIL program. To build rapport and to improve the efficiency of data capture, interviews were tape recorded [46] and then transcribed. In addition to the interview data, written evaluation reports from students and industry supervisors were reviewed and also triangulated with university policy documents. A total of 80 persons participated in the research including 40 students and 40 industry supervisors. Students from various disciplines participated in this research including 26 engineering, 8 information technology and 6 business and technology students. The placements also spanned several industries. 26 placements pertained to the ICT industry (Industry supervisors, Students 1-26), 5 from the medical industry (Industry supervisors, Students 27-31), 4 from mechanical engineering (Industry supervisors, Students 32-35) and 5 from the environmental sector (Industry supervisors, Students 36-40). Participants were questioned and asked to reflect on the level of innovation shown by students throughout the placement as well factors that hindered or fostered their innovative ability through the WIL process.

Guided by themes emerging from the WIL literature, data analysis was carried out using data from students and industry supervisor interview transcripts, evaluation forms and university policy documents. NVivo was used to assist with data analysis. It was used to code data and categorize it via themes that resonated with the literature [47]. Data from multiple sources including students and industry supervisors as well as university documentation increased the validity and reduced bias in the analysis [48-50].

4. Results

The results reflected key factors for developing innovation ecosystems through WIL as a nexus between university and industry. Figure 1 presents the conceptual framework which stemmed from the literature and will be discussed further in this section.

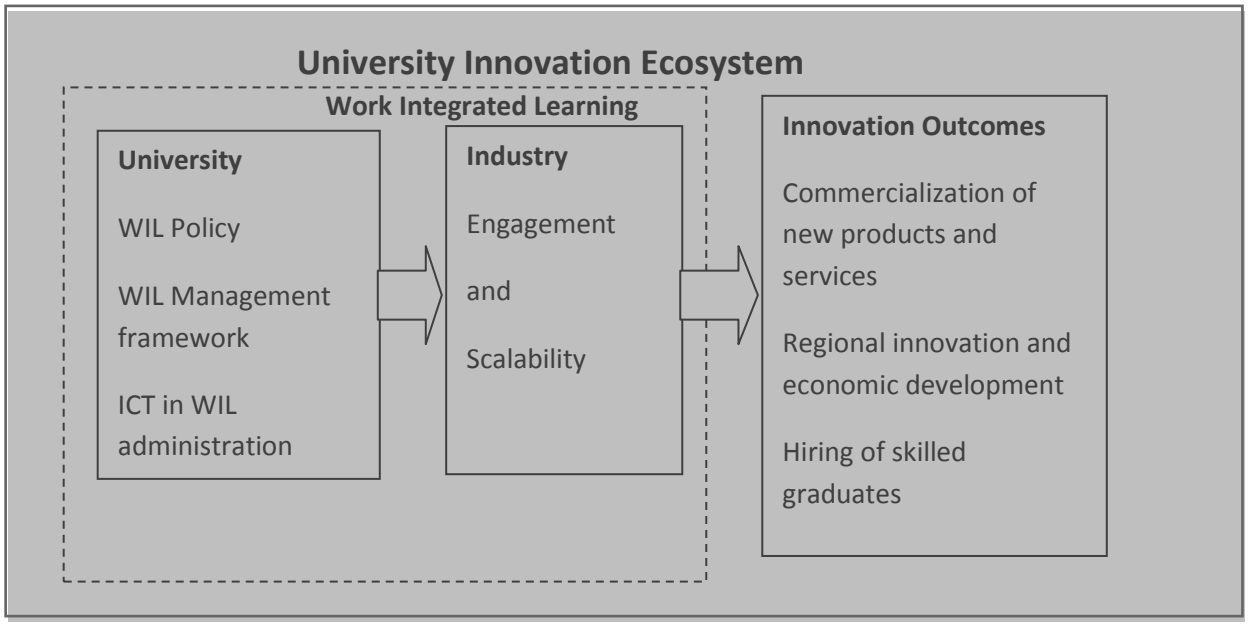

Fig 1: Conceptual Framework for Building Innovation Ecosystems through WIL

4.1. WIL Policy

A review of policy documents at the case university under investigation revealed that a university-wide Work Integrated Learning Policy was established to support the 'aim of providing WIL opportunities in its courses and to provide a systematic and comprehensive framework for the development and operation of WIL' [51, p. 1]. This policy aimed to foster quality assurance in the delivery of practicum topics throughout the university. For instance, it required that Faculties ensure that written agreements are signed between the university and the host organization prior to placement, outlining the roles and responsibilities of each party such as the need for confidentiality,

insurance and workplace health and safety training be provided to students before commencing their placements both by the university and also by the host organization on specific job-relevant issues. Industry supervisors expressed that the provision of the agreement by the university made the process efficient with role clarity from the onset. In some cases in host organizations where intellectual property was paramount, students were required to sign additional confidentiality agreements. There were a couple cases in which host organizations insisted that their agreements be signed by the university rather than the university-led agreement and these circumstances had to be reviewed by university legal professionals to determine acceptability.

> ***Our organization engages hundreds of students each year – either through providing scholarships or students undertaking their research work here. Additional University agreements for the same student engagement often contain conflicting or duplicate terms or otherwise relate only to the arrangements between the student and the university. To avoid any resulting uncertainty or inconsistency, and to save expending unnecessary time, we consider it unnecessary to be a party to additional university agreements. (Industry supervisor 40)***

Despite the WIL policy whereby university or industry-driven agreements were in place with industry hosts and quality practices implemented throughout the university in the administration of WIL programs, a review of broader policies reflected a lack of integration of WIL measures in other university-wide recruitment and promotion policies and Faculty-level performance management policies, with the focus being on traditional research, teaching and administration areas without explicit mention of WIL. Therefore, while important steps have been taken towards a university-wide WIL policy, more integration was needed within other university and faculty policies to ensure that the university's strategic priority of WIL is successfully implemented in practice.

4.2. Management

The placement program under investigation was managed by a team of people. It had an overall head, an academic appointed as WIL coordinator who was responsible for official communication about the program as well as selected academics from each discipline responsible for assisting students in identifying placement opportunities within those relevant industries and an administrative staff member for assistance with administrative issues such as disseminating marketing material and managing industry agreements. Once each placement was finalized, for each student, the university appointed an academic supervisor who was responsible for confirming with the student and host organization the nature of the project or other work being undertaken, and monitoring the student's progress. The qualitative data revealed that students appreciated the level of supervision provided:

> ***My academic supervisor was first of all able to assist me with getting a work placement and since then has been in contact regarding assignments and how I have been going. He has been very supportive and always provides help when required. (Student 1)***

The faculty's WIL policy involved visits by the academic supervisor to each student at their place of work so that early contact was initiated with the student and supervisor, and regular face-to-face contact was facilitated. The purposes of the visits were to ensure that host organizations provide any specific workplace health and safety training as they would to any employee during induction; ensure that adequate facilities and resources are available to the student; ensure that the student is actively engaged in meaningful tasks and exposure to key people within the organization; verify the student's progress with the firm and; explore opportunities for other forms of interaction and collaboration between the university and the host organization. In addition to the initial work undertaken by the WIL coordinator, administrator and discipline representatives, the academic supervisor was instrumental in maintaining and developing the relationship with the firm given face-to-face meetings with the firm which is important in improving understanding of the firm's activities and directions and in identifying opportunities for further engagement and scalability. The qualitative data reflected that students were pleased with the visits and involvement of their academic supervisors: ***'I wish to thank [my academic supervisor] for taking time out of his busy schedule to visit me at my placement' (Student 2).***

Similarly, firms were pleased with the overall management of the program**: '*I think that the program is operating is of a very high standard and is very professional' (Industry supervisor 3).***

4.3. ICT Systems

University-wide ICT systems also facilitated engagement with firms and scalability as the number of firms and students grew. The university under investigation used ICT systems including InPlace and PrePlace. These systems aimed to support Schools in meeting WIL policy requirements. InPlace was the university-wide placement management system and was launched in 2011. All documents associated with placements were stored in InPlace including organizational contact information, industry agreements, work plans, student reports and evaluation forms. InPlace facilitated quality assurance in the placement process as required documents such as industry agreements can be verified and monitored. Students were mapped to placements and academic supervisors via InPlace so that staff and students have access to relevant documents via InPlace.

Launched in 2012, PrePlace was a web-based program which aimed to prepare students for commencing their placements. It addressed a range of issues through assessment tasks including university requirements and

expectations for the placement such as criteria for withdrawal; workplace health and safety including understanding risks that may occur on placement, their rights and appropriate approaches to addressing these issues; case study scenarios to develop problem solving skills; approaches to utilize feedback; and the exposure to developing professional skills. Students could track their progress through the program [52].

4.4. Industry Engagement and Scalability

The results revealed that a number of industry supervisors commended the level of engagement with the university and indicated that they will continue to participate in the placement program and explore additional opportunities for collaboration. This renewal of commitment bodes well for the scalability of the program.

> ***The scheme was good as it provided us with a good, knowledgeable resource that we would otherwise not be able to afford as a small company. We would be happy to discuss further collaboration with the university in future. (Industry supervisor 4)***
>
> ***The Industry Placement scheme has worked well and we would consider continued support of the scheme. (Industry supervisor 32)***

Similarly, some outstanding students were also instrumental in making substantial contributions to firms and paving the way for increased numbers of placement opportunities at the host organizations. One student at an internationally leading IT company became the student ambassador for that company and was pivotal in ensuring that several future students benefitted from placement opportunities at that company: *I am in a good position to help the university if you need somebody to speak about internships at the company (Student 5).* Another student at a leading medical device company facilitated engagement with the appropriate human resource and management contacts at the company to negotiate an agreement between the university and the host organization for the placement of future students.

> ***There is another person in the division I am working with who came from [our university] as well. We were thinking that [the university] could easily have a student placement agreement with [host organization] as [host organization] run a student placement program here in Sydney that mainly draws students from [another university]. The person that I was talking to while organizing my placement was [HR contact name and direct email]. (Student 28)***

Following his placement, Student 28 progressed to doing a PhD at the host organization in conjunction with the university, thereby strengthening further university-industry engagement around collaborative research.

4.5. Outcomes

Qualitative data confirmed that innovation outcomes resulted from the WIL program. This included the commercialization of products and services:

> ***[Student 5] found creative ways to apply his knowledge to a completely new application and even added some of his own twists to make things even better. (Industry supervisor 5)***
>
> ***[Student 6] was able to take the basic project guidelines and interpret a required outcome, adding tasks and research as necessary to achieve a full solution. (Industry supervisor 6)***
>
> ***I found through the whole development process I was able to be creative and try different solutions in both the firmware and circuit design as there was often more than one solution. (Student 6)***
>
> ***[Student 27] demonstrated excellent creativity in his five-month project. It was a very open-ended project at the beginning and [Student 27] led our group in several brainstorming activities that led to a very interesting final product. (Industry supervisor 27)***
>
> ***This project was a first for [the firm], and while we had a clear objective in mind, it was [Student 33's] role to translate that into a final product. This required significant innovation and creativity – developing entirely new tools, experimentation and trail by error to get the right outcome for [the firm]. (Industry supervisor 33)***

Additionally, regional innovation and economic development outcomes were also achieved. For instance in a particular case, an IT student developed a new website for an accommodation facility which provided links to a range of businesses in the region such as tour companies, wineries and restaurants:

> ***As [the firm's] website advertises the greater Port Noarlunga area, other businesses in the area have an interest to have their business promoted on the site and possibly be included in package options offered by [the firm]. (Student 8)***

Similarly, the industry supervisor also echoed the contribution of the placement to regional innovation and economic development:

> ***We are a small business in providing Tourism Accommodation. [Student 8] understood well that whilst we are promoting our own business we are also a part of something larger. Our culture is to always be mindful to create a tourism experience which promotes [the firm] along with Port Noarlunga Township and surrounding area as we are creating economic benefit to the area. (Industry supervisor 8)***

Industry supervisors also confirmed that they would hire skilled students on completion of the placement, thereby confirming recruitment outcomes from the program.

> ***I aim to employ [Student 9] at the end of his placement. (Industry Supervisor 9)***
> ***(Student 35) was an incredible asset and would be fantastic. I would have no issue offering (Student 35) as job.(Industry supervisor 35)***

5. Managerial Implications

This study has important managerial implications on both the university level as well as the national, government levels.

On the university level, it is important to develop university WIL management processes and integrate it with wider processes and policies for recruitment, promotion and performance management. Within the university environment, the areas of teaching and research usually dominate these wider policies, while the area of industry engagement suffers from less recognition. As a result, university-industry engagement may not be fully leveraged as it is often under-resourced and under-rewarded. For instance, Garrett-Jones et al. [53] argue that researchers collaborating with industry face the challenge on reconciling the reward system focused on 'discovery' in academia with need to focus on 'application' in industry. Similarly, university policies surrounding work load allocations, performance evaluation, academic job profiles and promotions should adequately include WIL functions.

These findings can be valuable to a range of university stakeholders. For instance, presidents, vice chancellors or heads of strategy such as pro-vice chancellors or deputy vice chancellors in universities that seek to position themselves as innovative or entrepreneurial universities may find this paper of interest in providing a practical approach through WIL to focus on the student involvement in innovation ecosystems. Additionally, coordinators of university WIL programs, industry engagement units, technology transfer offices or business incubators in universities may deem this study useful in identifying wider policies and frameworks to ensure that strategic university aims towards innovation can be implemented successfully in practice. Overall, the study provides an insightful case study to contribute to informing university innovation processes and policies regarding the pivotal role of WIL as universities seek to shift from ivory tower institutions to innovation channels.

On a national governmental level, it moves beyond the prevailing preoccupation with patents and provides indicators that can be used to assess the innovation outcomes of university innovation ecosystems such as the commercialization of new products and services, regional innovation and economic development and the hiring of skilled students. Consequently, government policies surrounding innovation grants should include industry engagement grants to foster the development of WIL capability in various disciplines and industries identified for growth priority. Such grants will not only assist universities in their outreach efforts and in establishing a greater pool of potential WIL hosts, but it will assist businesses in acquiring talented students with desirable skills for boosting their innovation capability.

6 Conclusion

This paper contributes a framework for building university innovation ecosystems by focusing on the core component of work integrated learning as a nexus between university and industry. Unlike existing research that focuses on staff innovation activities, this research examines the largely ignored yet critical role of the student in the innovation process. Indeed, the student is a missing piece of the puzzle in the thrust to reform the university sector towards being more innovative. Yet, the student represents an abundant flow of talent and ideas and the future promise of an innovative workforce.

By adopting an emphasis on the student, the study uncovers vital factors needed to build university innovation ecosystems. Such factors include the necessity of university WIL policies and its integration with wider policies; WIL management frameworks and the important role of the WIL academic and administrative team; and ICT tools to support the WIL administrative process. Furthermore it shares insights to build engagement and foster scalability of WIL programs for instance outreach efforts to alumni, focuses on key nodes and ensuring renewal of interest in participating in WIL programs and other forms of collaborative activities.

Certainly, this study provides a fertile ground for future research and uncovers pertinent insights in the area of university innovation ecosystems and the instrumental role of WIL in the nexus between university and industry in the age of the innovative university.

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